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on November 4, 2003

Kathy E. Raymond
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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant :	Earl Ault	Docket No. :	IL-10680
Serial No. :	09/661,653	Art Unit :	2828
Filed :	09/14/2000	Examiner :	Davienne N. Monbleau
For :	HIGH POWER LASER HAVING A TRIVALENT TITANIUM LIQUID HOST		

RECEIVED NOV 12 2003 TECHNOLOGY CENTER 2800

Honorable Commissioner for Patents
Alexandria, VA 22313-1450

Attention: Board of Patent Appeals and Interferences

Dear Sir:

APPELLANT'S BRIEF (37 C.F.R. § 1.192)

This brief is submitted in support of appellant's notice of appeal from the decision of the Examiner, mailed August 27, 2003, finally rejecting claims 1, 3, 4, 5, and 9 of the subject application. Appellant's notice of appeal was mailed October 6, 2003.

This brief is transmitted in triplicate per 37 C.F.R. § 1.192.

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I. IDENTIFICATION OF THE REAL PARTY OF INTEREST

The real party in interest is:

The Regents of the University of California and the United States of America as represented by the United States Department of Energy (DOE) by virtue of an assignment by the inventor as duly recorded in the Assignment Branch of the U.S. Patent and Trademark Office.

II. IDENTIFICATION OF RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF ALL THE CLAIMS, PENDING OR CANCELLED, AND IDENTIFYING THE CLAIMS APPEALED

The application as originally filed contained claims 1-9.

Claims 2, 6, 7, and 8 were cancelled.

The claims on appeal are claims 1, 3, 4, 5, and 9.

The claims on appeal, claims 1, 3, 4, 5, and 9 are reproduced in Appendix A.

IV. STATUS OF ANY AMENDMENT FILED SUBSEQUENT TO FINAL REJECTION

There have been no amendments filed subsequent to the final rejection mailed August 27, 2003.

V. SUMMARY OF THE INVENTION

The invention defined by the claims on appeal is described below with citations to pages and lines of the specification and using reference numbers from the drawings. This is done to comply with Section 1206 of the MPEP and is not to be construed as

limiting the claimed invention.

(Claims 1, 3, 4, 5, and 9; Specification Page 6, lines 15-21 and Page 7, lines 1-2.)

The present invention shows and claims a system wherein a Ti^{+3} bases liquid is optically excited by a semiconductor diode. Since the host is a liquid, it can be removed from the optical cavity when it becomes heated avoiding the inevitable optical distortion and birefringence common to glass and crystal hosts. The Ti^{+3} bases liquid laser, operating in the near infrared at 800-900 nm, is capable of producing tens of kilowatts of cw power with good beam quality. Applications include power beaming, laser guide stars, illuminators, material processing, remote sensing, laser weapons, and tactical defense systems.

The system is shown in Drawing Figure 1, attached as Exhibit A, wherein a Ti^{+3} bases liquid is optically excited by semiconductor diodes 23 and 23′ and circulated in a closed loop circulation system 21. The closed loop circulation system 21 circulates the trivalent titanium ions dissolved in a liquid host through a first lasing chamber 22 in a first linear direction in the closed loop circulation system 21 and into a second lasing chamber 22′ and through the second lasing chamber 22′ in a second linear direction in closed loop circulation system 21 and back into the first lasing chamber 22. The second linear direction is opposite to the first linear direction.

(Claims 1, 3, 4, 5, and 9; Specification Page 9, lines 3-22 and Page 10, lines 1-9; Drawing Figure 1.)

The drawings and in particular to FIG. 1, attached as Exhibit A, show an embodiment of a laser 20 constructed in accordance with the present invention. A liquid lasing medium is circulated through a closed loop 21. The closed loop 21, filled with a Ti^{+3} bases liquid, circulates the liquid into and out of a pair of lasing chambers 22 and 22′. A pair of semiconductor pumping devices 23 and 23′ are located within the lasing chambers 22 and 22′. The semiconductor pumping devices 23 and 23′ are used to optically excite the liquid lasing medium within the optical cavities, lasing chambers 22

and 22′. The semiconductor pumping devices 23 and 23′ can be a semiconductor diode lasers or light emitting diodes. The pump 24 circulates the lasing liquid through a pair of heat exchangers/flow conditioners 25 and 25′, a static pressurizer 26, and the optical cavities 22 and 22′.

The laser 20 includes a laser cavity having a first lasing chamber 22, a second lasing chamber 22′, trivalent titanium ions dissolved in a liquid host within the first lasing chamber 22, and trivalent titanium ions dissolved in a liquid host within the second lasing chamber 22′. A first semiconductor pumping device 23 is operatively connected to the first lasing chamber 22 for optically exciting the trivalent titanium ions dissolved in the liquid host within the first lasing chamber 22. The first semiconductor pumping device 22 comprising at least one semiconductor diode for optically exciting the trivalent titanium ions dissolved in the liquid host within the first lasing chamber 22. A second semiconductor pumping device 23′ is operatively connected to the second lasing chamber 22′ for optically exciting the trivalent titanium ions dissolved in the liquid host within the second lasing chamber 22′. The second semiconductor pumping device comprising at least one semiconductor diode for optically exciting the trivalent titanium ions dissolved in the liquid host within the lasing second chamber 22′.

The laser 20 includes a closed loop circulation system 21 for circulating the trivalent titanium ions dissolved in a liquid host through the first lasing chamber 22 in a first linear direction into the closed loop circulation system 21 and into the second lasing chamber 22′ and through the second lasing chamber 22′ in a second linear direction into the closed loop circulation system 21 and back into the first lasing chamber 22. The second linear direction is opposite to the first linear direction. The closed loop circulation system 21 comprising a first portion for circulating the trivalent titanium ions dissolved in a liquid host into and out of the first lasing chamber 22 in said first linear direction and a second portion for circulating the trivalent titanium ions dissolved in a liquid host into and out of the second lasing chamber 22′ in a second

direction that is opposite to the first linear direction.

Thermally induced optical phase errors are produced by closed loop circulation system 21. The laser 20 includes a system for correcting the thermally induced optical phase errors by circulating the trivalent titanium ions dissolved in a liquid host into and out of the first and second lasing chambers 22 and 22' in a first direction and in a second direction that is opposite to said first direction.

Windows at each end of the channel define an excitation volume. Two gain blocks with opposite flow directions are used to compensate for the static optical wedge induced by fluid heating. The linear component, or optical wedge, that builds up in the liquid as it flows past the pump windows is predictable and steady. By arranging two cells in series in the laser cavity having opposite flow directions allows the wedge to be canceled.

The present invention utilizes trivalent titanium ions dissolved in a liquid host. The shifts in absorption and emission seen when this ion is placed in glasses demonstrate it is possible to achieve powerful laser action in the 800 to 900 nm region when this ion is excited by 808 nm semiconductor diodes. Solar cells are one of the primary receivers of such radiation at 1.053 micron. What is needed is the equivalent of a Ti:Sapphire solid state laser that is in the liquid state that can be pumped with presently available semiconductor diodes at around 800 nm. The present invention utilizing trivalent titanium ions dissolved in a liquid host provides the answer.

<u>(Claims 1, 3, 4, 5, and 9; Specification Page 16, lines 3-7; Drawing Figure 1.)</u>

Two cells are used with opposite flow directions to cancel the linear optical wedge induced by waste heat in the fluid. The projected phase error of the output beam is about 0.4 waves peak to peak after correction with a single actuator deformable mirror.

VI. CONCISE STATEMENT OF THE ISSUES PRESENTED FOR REVIEW

Claims 1, 3, 4, 5, and 9 stand finally rejected under 35 U.S.C. §103(a) as being obvious over the combination of the Kocher reference (U. S. Patent No. 3,663,891) and the Chun reference (U. S. Patent No. 4,654,855) and the Scheps reference (U. S. Patent No. 5,307,358). It is Appellant's position that none of the three references used in the Office Action show certain significant elements of Appellant's rejected claims, and that it would not be obvious to combine the three references because the Kocher reference is a liquid laser, the Chun reference is a gas laser, and the Scheps reference is a solid state laser. Significant features from such different lasers can not be substituted from one reference to another.

The six (6) issues A, B, C, D, E, and F presented for review are:

Issue A. Whether the references, either individually or combined, actually show Appellant's claim element a closed loop circulation system that circulates the trivalent titanium liquid host "through said first lasing chamber in a first linear direction" and "through said second lasing chamber in a second linear direction" with said second linear direction being opposite to said first linear direction?

Issue B. Whether the references, either individually or combined, show Appellant's claim element "said closed loop circulation system comprising" a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction?

Issue C. Whether the references, either individually or combined, show Appellant's claim element of optical phase errors are produced by said a closed loop circulation system and "a system for correcting said thermally induced optical phase errors"?

Issue D. Whether the references, either individually or combined, show Appellant's claim elements "trivalent titanium ions dissolved in a liquid host" within said first lasing chamber and/or "trivalent titanium ions dissolved in a liquid host" within said second lasing chamber?

Issue E. Whether the references, either individually or combined, show Appellant's claim elements a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for "optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber" and/or a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for "optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber"?

Issue F. Whether the references, either individually or combined, show the "combination" of claim elements as defined by claims 1, 3, 4, 5, and 9?

VII. GROUPING OF THE CLAIMS

Group I – Claims 1, 3, 4, 5, and 9 (all of the claims on appeal). The issues A, B, D, and F cover the claims in this group.

Group II – Claim 4. The issue C covers the claim in this group.

Group III – Claim 1. The issue E covers the claim in this group.

VIII. ARGUMENTS OF THE APPELLANT, WITH EACH ISSUE IN SEPARATE HEADINGS, WITH RESPECT TO EACH ISSUE PRESENTED FOR REVIEW

Issue A. Whether the references, either individually or combined, actually show the claim element a closed loop circulation system that circulates the trivalent titanium liquid host "through said first lasing chamber in a first linear direction" and "through said second lasing chamber in a second linear direction" with said second linear direction being opposite to said first linear direction?

Appellant respectfully submits that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show this claim element. This element is specifically defined in Appellant's claim 1, lines 18-23 as "a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction."

The American Heritage® Dictionary defines "linear" as: "1. Of, relating to, or resembling a line; straight. 2a. In, of, describing, described by, or related to a straight line. b. Having only one dimension." Appellant's Drawing Figure 1, Exhibit A, shows the liquid host flowing "through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber, said second linear direction being opposite to said first linear direction."

The Kocher reference, which is the primary reference cited against Appellant's rejected claims 1, 3, 4, 5, and 9, does not show a liquid host flowing through said first lasing chamber in a first linear direction or flowing and through said second lasing

chamber <u>in a second linear direction</u>. As clearly shown in Figure 1 of the Kocher reference and described in the Kocher reference specification, the Kocher fluid enters the chamber 34 (containing window 52) and turns abruptly at a right angle. The specification in col. 5, lines 61-64 states, "The flow of liquid entering input chamber 34 may be subject to large scale eddying and other disturbances due to the abrupt enlargement of the flow passageway and change in the direction of flow." Also, the Kocher reference shows and describes the Kocher fluid as entering the chamber 36 (containing window 54) and turning abruptly at a right angle. The specification in col. 6, lines 4-12 states, "The flow control portion 59 of window 54 provides a similar function as the active material leaves the active region of the cell. The stream of photons is transmitted through window 54 while the liquid active material flows around the cylindrical portion 60 of the flow control portion of window 54. Any disturbances which may occur in the flow of the active material in the output chamber therefore occur while the liquid is separated from the stream of photons."

The Chun reference, which is one of the secondary references cited against the rejected claims 1, 3, 4, 5, and 9, does not even show a liquid host nor does it show a host of any kind flowing <u>through said first lasing chamber in a first linear direction</u> or flowing and <u>through said second lasing chamber in a second linear direction</u>. The Chun reference shows a pulsed electrical discharge gas laser. As clearly shown in Figure 1A of the Chun reference and described in the Chun reference specification, a gas is circulated in an oval passage. The Chun specification, in col. 2, lines 28-31, describes the circulation in Figure 1, as, "In FIG. 1, the gas 1 circulates through the device in the direction depicted by arrows 6 so as to flow successively through heat exchangers 7 and the active regions 4 of the device."

The Scheps reference, which is one of the secondary references cited against the rejected claims 1, 3, 4, 5, and 9, does not even show a liquid laser system and clearly does not show a host of any kind flowing <u>through said first lasing chamber in a first</u>

linear direction or flowing and through said second lasing chamber in a second linear direction. The Scheps reference shows and describes a solid state laser not a liquid laser. There is no circulation of a host in the Scheps reference. The Scheps reference specification states, "Numerous crystalline and amorphous materials have been found to be suitable for prisms for intracavity use in a laser" in col. 8, lines 26-28, and "It should be pointed out that prism materials are not restricted solely to solid state materials. Liquid prisms have been used to some extent in the visible region and also in the ultraviolet." The specific embodiments shown in the Scheps reference are solid state prisms and not liquid prisms.

Issue B. Whether the references, either individually or combined, show Appellant's claim element "said closed loop circulation system comprising" a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction?

Appellant respectfully submits that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show this claim element. This element is specifically defined in Appellant's claim 1, lines 23-28 as "said closed loop circulation system comprising a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction."

The American Heritage® Dictionary defines "linear" as: "1. Of, relating to, or resembling a line; straight. 2a. In, of, describing, described by, or related to a straight line. b. Having only one dimension." Appellant's Drawing Figure 1, Exhibit A, shows

"said closed loop circulation system comprising a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction."

The Kocher reference, which is the primary reference cited against Appellant's rejected claims 1, 3, 4, 5, and 9, does not show a closed loop circulation system comprising a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction. As clearly shown in Figure 1 of the Kocher reference and described in the Kocher reference specification, the Kocher fluid enters the chamber 34 (containing window 52) and turns abruptly at a right angle. The specification in col. 5, lines 61-64 states, "The flow of liquid entering input chamber 34 may be subject to large scale eddying and other disturbances due to the abrupt enlargement of the flow passageway and change in the direction of flow." Also, the Kocher reference shows and describes the Kocher fluid as entering the chamber 36 (containing window 54) and turning abruptly at a right angle. The specification in col. 6, lines 4-12 states, "The flow control portion 59 of window 54 provides a similar function as the active material leaves the active region of the cell. The stream of photons is transmitted through window 54 while the liquid active material flows around the cylindrical portion 60 of the flow control portion of window 54. Any disturbances which may occur in the flow of the active material in the output chamber therefore occur while the liquid is separated from the stream of photons."

The Chun reference, which is one of the secondary references cited against the rejected claims 1, 3, 4, 5, and 9, does not even show a liquid host nor does it show a

closed loop circulation system circulating a liquid host. The Chun reference shows a pulsed electrical discharge gas laser. As clearly shown in Figure 1A of the Chun reference and described in the Chun reference specification, a gas is circulated in an oval passage. The Chun specification, in col. 2, lines 28-31, describes the circulation in Figure 1, as, "In FIG. 1, the gas 1 circulates through the device in the direction depicted by arrows 6 so as to flow successively through heat exchangers 7 and the active regions 4 of the device."

The Scheps reference, which is one of the secondary references cited against the rejected claims 1, 3, 4, 5, and 9, does not even show a liquid laser system and clearly does not show a closed loop circulation system circulating a liquid host. The Scheps reference shows and describes a solid state laser not a liquid laser. There is no circulation of a host in the Scheps reference. The Scheps reference specification states, "Numerous crystalline and amorphous materials have been found to be suitable for prisms for intracavity use in a laser" in col. 8, lines 26-28, and "It should be pointed out that prism materials are not restricted solely to solid state materials. Liquid prisms have been used to some extent in the visible region and also in the ultraviolet." The specific embodiments shown in the Scheps reference are solid state prisms and not liquid prisms.

<u>**Issue C.**</u> Whether the references, either individually or combined, show Appellant's claim element of optical phase errors are produced by said a closed loop circulation system and "a system for correcting said thermally induced optical phase errors"?

Appellant respectfully submits that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show this claim element. This element is specifically defined in Appellant's claim element is defined in claim 4 as, "wherein thermally induced optical phase errors are produced by said a closed loop circulation system for circulating said trivalent titanium ions dissolved in a

liquid host and wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said lasing chamber in a first direction and said second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out said lasing chamber in a second direction that is opposite to said first direction provides a system for correcting said thermally induced optical phase errors."

The Kocher reference is the only reference that mentions "optical distortion." The Kocher reference identifies the problem of "optical distortion" but has a solution to the problem that is different from the solution defined by Appellant's claims.

The Kocher reference states, "Since the optical distortion of the laser output beam is caused primarily by the unequal liquid velocities in the cell, it appeared that this distortion could be substantially eliminated by creating a more uniform liquid velocity" in col. 2, lines 26-29, and "Large scale disturbance in the active material entering the cell are smoothed while the liquid flows around the flow control means thereby preventing these disturbances from causing distortion in the output laser beam" in col. 3, lines 16-20.

The Kocher reference does not show Appellant's claim element of said first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said lasing chamber in a first direction and said second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out said lasing chamber in a second direction that is opposite to said first direction provides a system for correcting said thermally induced optical phase errors.

Issue D. Whether the references, either individually or combined, show Appellant's claim elements "trivalent titanium ions dissolved in a liquid host" within said first lasing chamber and/or "trivalent titanium ions dissolved in a liquid host" within said second lasing chamber?

Appellant respectfully submits that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show these claim

elements. These elements are specifically defined in Appellant's claim 1, lines 5-7, as "trivalent titanium ions dissolved in a liquid host within said first lasing chamber" and/or "trivalent titanium ions dissolved in a liquid host within said second lasing chamber." These elements are specifically defined in Appellant's claim 9, lines 5 and 6, as "a lasing liquid containing trivalent titanium ions dissolved in a liquid host within said first lasing chamber and said second lasing chamber."

The secondary Scheps reference is the only reference that mentions "trivalent titanium ions." The primary Kocher reference and the secondary Chun reference do not include "trivalent titanium ions."

The secondary Scheps reference states, "Solid state crystalline laser gain elements which are doped with impurity ions for laser operation are highly suitable for this type of laser, as are ion doped glasses or other amorphous materials" in the abstract, "The design of the optical laser gain element disclosed herein is generic and could be used either in laser systems with several fixed wavelength transitions such as Nd:YAG where the 1.064.mu. transition operates simultaneously with laser lines at 1.32, 1.34, 1.36, 1.42, 1.44 and 0.942.mu. or in continuously tunable laser systems such as Ti:sapphire, as mentioned above, which tunes between approximately 650 nm and 1.1.mu. Other exemplary laser systems are: Cr:LiCAF which can be tuned between about 720 nm and 850 nm; alexandrite (Cr.sup.3+ -doped BeAl.sub.2 O.sub.4) which tunes between approximately 760 nm and 1.mu.; Cr:LiSGAF which can be tuned between approximately 800 and 900 nm; Tm:YAG which can be tuned between about 1.87.mu. and 2.6.mu.; Tm:YSGG which can be tuned between about 1.85.mu. and 2.14.mu.; Tm:GSGG which can be tuned between about 1.92.mu. and 2.04.mu.; Ho:YAG which can be tuned between about 2.05.mu. and 2.51.mu. and between about 2.84.mu. and 2.92.mu.; and Er:YAG which can be tuned between about 2.7.mu. and 2.96.mu. The optical laser resonator gain element can be resonantly pumped or flash pumped. The wavelength range over which the laser system operates is determined by the dopant or

dopants used in the laser gain element as well as by the reflective coatings and transmission of the optical elements making up the resonator that defines the laser resonator cavity. As discussed above, some of the exemplary dopants that can be used in laser gain elements are Er.sup.3+, Ho.sup.3+, Nd.sup.3+, Cr.sup.3+, Ti.sup.3+ and Tm.sup.3+. In addition, other activator ions which can be used are various ones of divalent (Mn.sup.2+, Co.sup.2+ and Ni.sup.2+) and quadrivalent (Cr.sup.4+ and V.sup.4+) transition metal ions; trivalent actinides (U.sup.3+); and divalent rare earth ions (Sm. sup.2+, Tm.sup.2+ and Eu.sup.2+)" in col. 5, lines 45-68 and col. 6, lines 1-11.

The secondary Scheps reference only shows systems with solid state lasers, but does state, "It should be pointed out that prism materials are not restricted solely to solid state materials. Liquid prisms have been used to some extent in the visible region and also in the ultraviolet. Since both dye lasers and chelate lasers utilize liquid gain media, this realization extends the utility of this inventive concept to liquids enclosed in a hollow prism as well as solid state laser gain elements." In col 8, lines 55-58, Appellant submits that the Scheps reference does not show enablement of a liquid laser because it does not teach an embodiment with a liquid. Further, the Scheps reference "liquid prism" is not a circulating liquid host containing "trivalent titanium ions dissolved in a liquid host" as defined in Appellant's claims. Further, the Scheps reference "liquid prism" is not described as having "trivalent titanium ions dissolved" therein.

Issue E. Whether the references, either individually or combined, show Appellant's claim elements a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for "optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber" and/or a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved

in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for "optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber"?

Appellant respectfully submits that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show these claim elements. These elements are specifically defined in Appellant's claim 1, lines 8-17 as, "a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber,

a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber."

The secondary Scheps reference is the only reference that mentions "trivalent titanium ions." The primary Kocher reference and the secondary Chun reference do not include "trivalent titanium ions."

The secondary Scheps reference only shows solid state crystalline laser gain elements which are doped with impurity ions for laser operation are highly suitable for this type of laser, as are ion doped glasses or other amorphous materials, and does not show any pumping device with any lasing chamber for optically exciting trivalent titanium ions dissolved in a liquid host within the lasing chamber.

Issue F. Whether the references, either individually or combined, show the "combination" of claim elements as defined by claims 1, 3, 4, 5, and 9?

Appellants respectfully submit that neither the Kocher reference, the Chun reference, nor the Scheps reference, either individually or combined, show an obvious combination of claim elements as defined by Appellant's claims within the meaning of 35 USC 103(a). Under MPEP §2142, there are three requirements to establish a prima facie case of obviousness. (1) There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. (2) There must be a reasonable expectation of success. (3) The prior art reference (or references when combined) must teach or suggest all the claim limitations. It should be noted that the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on Appellant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Appellants respectfully submit that the rejection fails under the obviousness test. The rejection fails under prong 1 of the obviousness test because there is no suggestion or motivation in the prior art to combine the Kocher reference, the Chun reference, and/or the Scheps reference. Under MPEP §2143.01, "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art." In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). There is no such teaching in the Kocher reference, the Chun reference, or the Scheps reference.

Appellants respectfully submit that the rejection also fails under the second prong of the obviousness test because there is no reasonable expectation of success of the claimed combination. The Kocher reference is directed to a liquid laser systems, the Chun reference is directed to a gas laser systems, and the Scheps reference is directed to a solid state laser systems. To substitute features from the Chun reference gas laser

systems or the Scheps reference solid state laser systems into the Kocher liquid laser systems would not have any reasonable expectation of success. The liquid, gas, and solid laser systems are so different the features can not be substituted from one system into another. For example the feature of doping the crystals in the Scheps reference solid state laser systems into the Kocher liquid laser systems would not have a reasonable expectation of success because doping applies to solids and does not apply to liquids.

Appellants respectfully submit that the rejection also fails under the first and third prong of the obviousness test because only through impermissible hindsight would motivation be found to combine in the Kocher reference, the Chun reference, and the Scheps reference. MPEP §2142 states "the tendency to resort to 'hindsight' based upon Appellant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art." Also, under MPEP §2143.01, "the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990).

IX. SUMMARY

In summary, none of the three references used in the Office Action show certain significant elements of Appellant's rejected claims. Further, it would not be obvious to combine the three references because the Kocher reference is a liquid laser, the Chun reference is a gas laser, and the Scheps reference is a solid state laser and significant features from such different lasers can not be "obviously" substituted from one reference to another.

It is respectfully requested that all of the claims on appeal (claims 1, 3, 4, 5, and 9) be allowed.

Respectfully submitted,

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Date: November 5, 2003

Attachments:

Appendix

Exhibit A

APPENDIX

Claim 1. A laser, comprising:

a laser cavity having

a first lasing chamber,

a second lasing chamber,

trivalent titanium ions dissolved in a liquid host within said first lasing chamber,

trivalent titanium ions dissolved in a liquid host within said second lasing chamber,

a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said first lasing chamber,

a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in said liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions dissolved in said liquid host within said lasing second chamber,

a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host through said first lasing chamber in a first linear direction into said closed loop circulation system and into said second lasing chamber and through said second lasing chamber in a second linear direction into said closed loop circulation system and back into said first lasing chamber,

said second linear direction being opposite to said first linear direction, said closed loop circulation system comprising

a first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in said first linear direction and

a second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in said second direction that is opposite to said first linear direction.

Claim 3. The laser of claim 1 wherein said closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host includes a pump and a heat exchanger.

Claim 4. The laser of claim 1, wherein thermally induced optical phase errors are produced by said a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host and wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host into and out of said lasing chamber in a first direction and said second portion for circulating said trivalent titanium ions dissolved in a liquid host into and out said lasing chamber in a second direction that is opposite to said first direction provides a system for correcting said thermally induced optical phase errors.

Claim 5. The laser system of claim 4, wherein said first portion for circulating said trivalent titanium ions dissolved in a liquid host includes a first flow channel and said second portion for circulating said trivalent titanium ions dissolved in a liquid host includes a second flow channel, said first flow channel and said second flow channel being of substantially equal length.

Claim 9. A laser system, comprising:

an optical cavity having

a first lasing chamber and

a second lasing chamber,

a lasing liquid containing trivalent titanium ions dissolved in a liquid host within said first lasing chamber and said second lasing chamber,

a first semiconductor pumping device operatively connected to said first lasing chamber for optically exciting said trivalent titanium ions dissolved in a liquid host within said first lasing chamber, said first semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions in the 800 to 900 nm region,

a second semiconductor pumping device operatively connected to said second lasing chamber for optically exciting said trivalent titanium ions dissolved in a liquid host within said second lasing chamber, said second semiconductor pumping device comprising at least one semiconductor diode for optically exciting said trivalent titanium ions in the 800 to 900 nm region,

a closed loop circulation system for circulating said trivalent titanium ions dissolved in a liquid host, said closed loop circulation system comprising a first portion for circulating said lasing liquid containing trivalent titanium ions dissolved in a liquid host into and out of said first lasing chamber in a first direction, and

a second-portion for circulating said lasing liquid containing trivalent titanium ions dissolved in a liquid host into and out of said second lasing chamber in a second direction that is opposite to said first direction, said closed loop circulation system including a pump and a heat exchanger.

EXHIBIT A

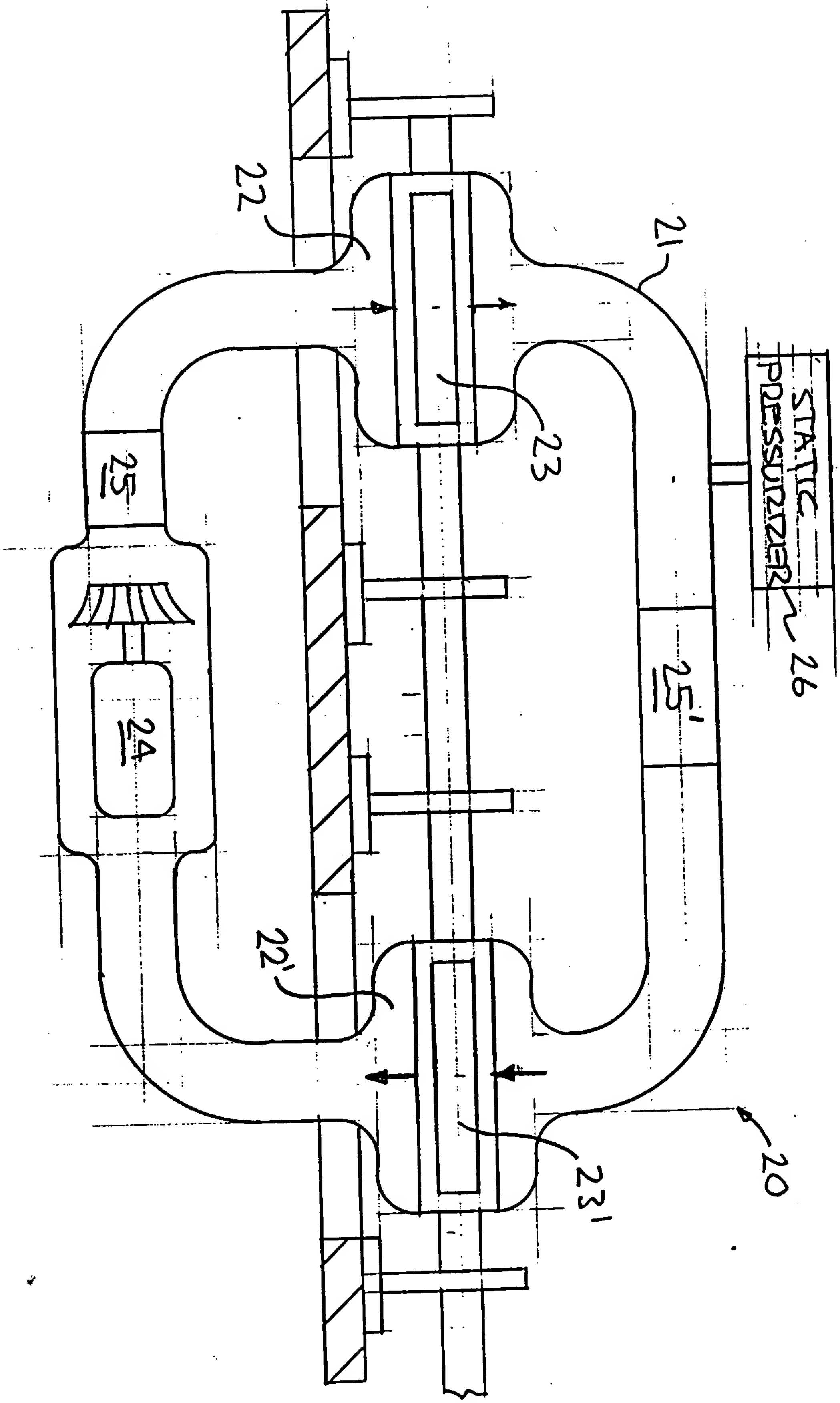

FIG. 1

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